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PROCEEDINGS

OF THE

ROYAL SOCIETY OF EDINBURGH.

1842–43. No. 21.

Monday, 5th December 1842.

Sir T. MAKDOUGALL BRISBANE, Bart., President, in the Chair.

The following communications were read:—

1. On the Construction of a New Music Hall. By Sir George S. Mackenzie, Bart.

The author noticed a variety of facts which were in direct opposition to the common notions entertained on the subject; and which led to the conclusion, that the chief object to be kept in view, was to destroy all sound that did not go directly from the source of sound to the ears of the audience, by preventing reflection. He described the plan of the Hall now building at the Assembly Rooms, the form of which is crucial, owing to the space on which it stands having been limited, and the necessity for connecting it with the pre-existing apartments; and he stated that he would have preferred a square, with the orchestra somewhat retired on one side. The new Hall was to be regarded as an experiment; and if one mode for destroying superfluous sound did not succeed, others would be tried.

2. On the Geology of Roxburghshire. Part 1. By David Milne, Esq. *See Proceedings on 9th January* 1843.

The following Donations of Books to the Society's Library were announced as having been received since the closing Meeting of last Session.

23. 8. 31. 1.

Report of the Eleventh Meeting of the British Association for the Advancement of Science, held at Plymouth in July 1841.—*By the Association.*

Nieuwe Verhandelingen van het Bataafsch Genootschap der proefondervindelijke Wijsbegeerte te Rotterdam. Vol. viii. St. 2.—*By the Society.*

Archives du Museum d'Histoire Naturelle Publiées par les Professeurs-Administrateurs de cet Etablissement. Tome i. Livr^{ns} 2, 3, 4, et Tome ii. Livr^{ns} 1, 2.—*By the Editors.*

A new Analogy for determining the distances of the Planets from the Sun, and of the Satellites from their Primaries.—*By the Author.*

The American Journal of Science and Arts, conducted by Professor Silliman, for April, July, and October.—*By the Editor.*

Scheikundige Onderzoekingen, gedaan in het Laboratorium der Utretchtsche Hoogeschool. Stuks 1, 2, 3.—*By the Editors.*

Proceedings of the London Electrical Society. Session 1841-42. Parts 3, 4, 5.—*By the Society.*

Voyage dans la Russie Méridionale et la Crimée. Planches, Livr^{n} viii. Par M. Anatole Demidoff.—*By the Author.*

Astronomische Nachrichten. Nos. 433-446.—*By Professor Schumacher.*

Observations Météorologiques faites a Nijne-Taguilsk (Monts Oural), Governement de Perm. 1841.—*By the Author.*

Novorum Actorum Academiæ Caesareæ Leopoldino-Carolinæ Naturæ Curiosorum Voluminis Undevicesimi Supplementum Alterum. —*By the Academy.*

The Quarterly Journal of Agriculture, and the Prize Essays and Transactions of the Highland and Agricultural Society of Scotland. June, September, and December.—*By the Society.*

Journal of the Statistical Society of London. Vol. V. Parts 1, 2, 3. —*By the Society.*

An Exposition of the Nature, Force, Action, and other properties of Gravitation on the Planets.—*By the Author.*

Tijdschrift voor Natuurlijke Geschiedenis en Physiologie. Uitgegeven door J. Vander Hoeven, M.D., en W. H. Vriese, M.D. Deel viii. St. 4; and Deel ix. St. 1.—*By the Editors.*

The Transactions of the Linnean Society of London. Vol. XIX. Part 1.

The Proceedings of the Linnean Society of London. Nos. 13, 14. —*By the Society.*

Ordnance Survey of the County of Kilkenny in Ireland. 49 sheets. —*By His Excellency the Lord Lieutenant.*

Bulletin de la Société Impériale des Naturalistes de Moscow. 1842. Nos. 1, 2.—*By the Society.*

Memoirs of the Literary and Philosophical Society of Manchester. (Second Series), Vol. VI.—*By the Society.*

Journal of the Asiatic Society of Bengal. Nos. 115, 118, 119, 120, and 121.—*By the Society.*

Six Lectures on Arithmetic, containing a familiar explanation of the principles and rationale of the General Rules of Arithmetic.—*By the Author.*

Transactions of the American Philosophical Society held at Philadelphia, for promoting useful knowledge. Vol. VIII. Part 1.

Proceedings of the American Philosophical Society. Nos. 20, 21, and 22.—*By the Society.*

The Ninth Annual Report of the Royal Cornwall Polytechnic Society. 1841.—*By the Society.*

Ueber das Magnetische Observatorium der Koniglich-Sternwarte bei Munchen, von Dr J. Lamont.—*By the Author.*

Die Galvanographie, eine methode, gemalte Tuschbilder durch galvanische Kupferplatten im Drucke zu Vervielfältigen, von Franz von Kobell.—*By the Author.*

Proceedings of the Royal Society. No. 53.

Philosophical Transactions of the Royal Society of London for the year 1842. Part 1.—*By the Royal Society.*

Astronomical, Magnetical, and Meteorological Observations made at the Royal Observatory, Greenwich, in the year 1840, under the direction of George Biddell Airy, Esq., Astronomer Royal. —*By the Royal Society.*

Proceedings of the Geological Society of London. Nos. 77 to 87. —*By the Society.*

Teoremi sulle Sezioni Coniche dimonstrati da Nicola Trudi. Nos. 5, 6, 7.—*By the Author.*

Seconde Mémoire sur les Kaolins ou Argiles a porcelaine. Par MM. Alexandre Brongniart et Malaguti.—*By the Authors.*

Forty-ninth Report of the Literary and Philosophical Society of Newcastle-upon-Tyne.—*By the Society.*

Flora Batava. Nos. 123 and 124.—*By the King of Holland.*

Notice respecting the Fossils of the Mountain Limestone of Ireland, as compared with those of Great Britain, and also with the Devonian System. By Richard Griffith, F.R.S.E., &c. &c.—*By the Author.*

Mémoires de l'Académie des Sciences de l'Institut de France. Tome xviii.

Mémoires Présentés par divers Savants à l'Académie Royale des Sciences de l'Institut de France. Tome vii.—*By the Royal Academy.*

Ueber die Abhaengigkeit der Physischen Populationskraefte von den einfachsten Grundstoffen der Natur mit specieller Anwendung auf die Bevolkerungs-Statistik von Belgien, von Dr Ferdinand Gobbi.—*By the Author.*

Mémoires de la Société de Physique et d'Histoire Naturelle de Génève. Tome ix. p^tie^ 2.—*By the Society.*

Journal of the Royal Asiatic Society of Great Britain and Ireland. No. 13.—*By the Society.*

Magnetische und Meteorologische Beobachtungen zu Prag, von Karl Kriel. (Zwieter Jahrgang.)—*By the Author.*

1st and 2d Bulletins of the Proceedings of the National Institution for the promotion of Science at Washington.—*By the Institution.*

Researches in Physical Geology. By W. Hopkins, Esq. Parts 1, 2, 3. —*By the Author.*

On the Errors of Chronometers, and Explanation of a new construction of the Compensation Balance. By E. J. Dent, Esq.—*By the Author.*

Twenty-second Report of the Council of the Leeds Philosophical and Literary Society, 1841–42.—*By the Society.*

Transactions of the Royal Cornwall Polytechnic Society, 1842. No. 1.—*By the Society.*

System der Krystalle, ein Versuch von M. L. Frankenheim, Professor an der Universitat von Breslau.—*By the Author.*

Abhandlungen der Königlichen Akademie der Wissenschaften zu Berlin, 1840.

Bericht über die zur Bekanntmachung geeigneten Verhandlungen der Kongl. Preuss. Akademie der Wissenschaften zu Berlin. Juli 1841 bis Juni 1842.—*By the Academy.*

Liber Cartarum Prioratus Sancti Andree in Scotia e Registro ipso in Archivis Baronum de Panmure hodie asservato. (Printed for the Bannatyne Club.)—*By O. Tyndall Bruce, Esq.*

The Grasses of Scotland. By Richard Parnell, M.D., F.R.S.E.—*By the Author.*

The Second Supplement, completing the Seventh Edition of Dr Turner's Chemistry. By Justus Liebig, M.D., and William Gregory, M.D.—*By the Editors.*

Transactions of the Society instituted at London for the Encouragement of Arts, Manufactures, and Commerce. Vol. LII. Pt. 2. —*By the Society.*

Journal of the Royal Geographical Society of London. Vol. XI. Pt. 2.—*By the Society.*

Abhandlungen der Mathematisch-Physikalischen Classe der Koeniglich Bayerischen Akademie der Wissenschaften. Band iii. Abth. ii.—*By the Academy.*

Prodromus zu einer neuen verbesserten Darstellungsweise der Hohern Analytichen Dynamik, vom Grafen Georg von Buquoy. 1 Lieferung.—*By the Author.*

Proceedings of the Zoological Society of London. Nos. 93 to 108. *By the Society.*

Transactions of the Royal Institute of British Architects. Vol. I. Pt. 2.—*By the Institute.*

Historical Transactions of the Royal Society of Copenhagen. 6 vols. —*By the Society.*

Pilote Français comprenant les Côtes Septentrionales de France depuis Barfleur jusqu'a Dunkerque. Publié par ordre du Roi. Partie 5me.—*Par le Department de la Marine.*

Ueber das farbige Licht der Doppelsterne und eineger anderer Gestirne des Himmels, von Christian Doppler.—*By the Author.*

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. Tome xiv. Nos. 13–26, et Tome xv. Nos. 1–8.—*By the Academy.*

Donations of extensive collections of valuable specimens in Mineralogy and Conchology to the Society's Museum, by Lord Greenock and Mr Stark, were also announced ; and the thanks of the Society were returned to the Donors by the President, viz. :—

1. A number of Mineral and Fossil Organic Specimens, from various localities.—*Presented by Lord Greenock.*
2. Specimens of Land and Fresh-water Shells, chiefly from the neighbourhood of Edinburgh.
3. Specimens of Marine Shells, chiefly from the Firth of Forth. And,
4. Specimens of Zoophytes, chiefly from the Firth of Forth.—*Presented by John Stark, Esq.*

John Goodsir, Esq., Conservator of the Museum of the Royal College of Surgeons of Edinburgh, proposed by Professor Syme, was duly elected an Ordinary Fellow.

Monday, 19*th December* 1842.

The Right Honourable Lord GREENOCK, Vice-President, in the Chair.

The following communications were read:—

1. Letter on Terrestrial Magnetism, addressed to the Secretary. By Professor Hansteen of Christiania.

CHRISTIANIA, *the* 22*nd April* 1842.

* * * * I HAVE the pleasure to send you two papers: the first on the changes, which the moment of a magnetical needle or bar undergoes as a function of the elapsed time, and of the variations of the temperature; the second, in the German language, is an extract of a letter to Professor Kupffer of St Petersburg, exhibiting the changes of the time of 300 horizontal vibrations, in Christiania, of my invariable magnetical cylinder, made by Dollond in 1819, from 1820 to 1839. In the Latin Programma, page 17, seven later observations, to this year, are annexed. In the first paper it is demonstrated by experiments, with nine different magnetical cylinders, that the moment M is a function of the time t, elapsed after its being magnetized, of the following form:—

$$M = C + B e^{-qt},$$

where $C = M_\infty$ is the value of M, when $t = \infty$, e the basis of the natural logarithms, q a constant depending of the quality and hardness of the steel, $B = M_0 - M_\infty$ is the whole variation of M between $t = 0$, and $t = \infty$. The moment of every magnetical needle has accordingly a limit C, which it cannot transgress; and every variable needle may be used to determine the intensity in a voyage, when only the three constants, B, C, q, are determined by three observations, including the whole time of the voyage. In page 13, you will find under No. 4, the history of the cylinder belonging to the "Hansteen Apparatus" of the Royal Society of Edinburgh, from November 5. 1821, to October 29. 1826. After its arrival at Edinburgh, it seems to have lost some more of its power, perhaps from coming into a higher temperature. For, according to my calculations, it should already have been almost invariable after 664 days. I shall only remark, that to such delicate researches as the variation of the moment of a magnetical needle, which is nearly constant, a single observation is not sufficient, as the daily regular and irregular variations may make 2″ to 3″, upon a time of 800″.

The variation of the time T of 300 vibrations, page 17, seems to point out a variation of the horizontal intensity, either periodical (of short period), or undulatory; for, as the time T has been without variation, or even decreased from 1820, 71, to 1823, 54, in the first period, where, according to the formula $M = C + B e^{-qt,}$ the decrease of M should have been greatest, the change of T may have its origin from a variation in the horizontal intensity of the terrestrial magnetism. It had a maximum in 1823, a minimum in 1828, or 1829, and another maximum in 1839. I have found the same difference between 1823 and 1827, by different other cylinders, and in different places, as Copenhagen, Altona, and Paris; also, the same difference between 1832 and 1839 in Göttingen, with the same cylinder. In the letter to Mr Kupffer, I sought to express this variation as a function of the longitude of the moon's ascending node; and, accordingly, the period should be 18⅔ years: the time to come will decide.

I have for four years observed the meteorological instruments here in Christiania, at five fixed hours, 7 — 9 forenoon, and 2 — 4 — 10 afternoon; in the last year are added 0^h and 7^h afternoon. From these observations I have calculated the constants a_1, a_2, α_1, α_2, μ in the formula,

$$\beta = \mu + \alpha_1 \sin(a_1 + t) + \alpha_2 \sin(a_2 + 2t),$$

where β is the variable height of the barometer, t the horary angle of the sun, μ the mean value of β in 24 hours for the whole month. These constants are calculated, and curves constructed, for every month in the year. By these constants I have found, that here, in Christiania, lat. 59° 54′ 42″.5, the barometer has two maxima and two minima in the nine months; but that in the three months, May, June, and July, when the sun is not six hours below the horizon, the nocturnal minimum vanishes, and the morning and evening maximum coincide in the night. In the winter months, November, December, January, when the day is only six hours, the oscillation in the afternoon is very little, so that it is evident, that, in greater latitudes, near the polar circle, the minimum in the afternoon will vanish, and the two maxima, morning and evening, will coincide in the afternoon. This apparent anomaly is, of course, a necessary consequence of the general rule, modified by the short day. I have in the same manner calculated ten years' observations in Dresden, by Inspector Lohrmann, six times per day, 0^h, 3^h, 6^h, 9^h, 18^h, 21^h. In Dresden, the two minima are visible through all the twelve months. I have sent the calculations and the curves to Mr Schumacher, in Altona, and hope he will publish them in his "Astron. Nachrichten." The whole oscillation, between the greatest maximum and lowest minimum in Christiania, is greater than that deduced from the observations of Mr Sommer at Königsberg. The mean temperature at Christiania is less than that stated by L. von Buch, that is, scarce more than 4¼° Reaumur.

In 1839 I made a voyage through Denmark and the northern parts of Germany, and observed the following horizontal intensities, expressed in absolute unities after the method of Gauss (unities of longitude = 1 millim., of weight 1 milligramme, of time = 1 second mean time). The observations are made with my standard cylinder D (*De mutationibus momenti*, page 16, 17) and are reduced to absolute quantity by the method, *ibid.*, page 40, by the constant logarithm, log. A, which, in the calculations, is assumed = 6,00811, instead of 6,00843.

Christiania, . . .	1839, April,	1.5470	Altona, Schumacher's garden, .	1839, Sept.	1.7085
... .	... June,	1.5485	Bremen, ...	1839, July,	1.7172
... .	... Oct.	1.5422	Hanover, ...	1839, Sept.	1.7490
... .	1841, April,	1.5464	Magdeburg, . . .	1839, Aug.	1.7662
Götheborg, . . .	1839, Sept.	1.5723	Leipzig, ...	1839, Aug.	1.8092
Copenhagen, . . .	... July,	1.6503	Dresden, ...	1839, Ang.	1.8252
... .	1840, ...	1.6517	Gotha, ...	1839, Aug.	1.8057
Kiel, ...	1839, Sept.	1.6819	Eisenach, ...	1839, Aug.	1.7973
Bramstedt, ...	... ...	1.6857	Cassel, ...	1839, Aug.	1.7834
Altona, Kessel's garden, ...	... July,	1.7120	Göttingen, . . .	1839, Aug.	1.7751*

Taking the horizontal intensity H, in absolute unities for Göttingen = 1.7751, and according to your observations, Göttingen = 0.9783, Dresden = 1.0007, Edinburgh = 0.838 (Paris = 1.000), I find for Edinburgh in absolute unities, from the observations—

$$\text{In Göttingen } H = 1.5205,$$
$$\text{In Dresden } H = 1.5284. \quad \text{Mean } 1.5244.5,$$

a little less than in Christiania. When T is the corrected time of 100 vibs. of the Edinburgh cylinder, No. 1, and $HT^{\circ} = A$, I find, supposing in Edinburgh T = 270″578.

$$\log. A = 5.04769.$$

As the horizontal intensity has so many variations, hourly, daily, monthly, regular and irregular, and undulatory, or perhaps periodical variations in 18–19 years, I find the comparison with Paris, especially when it is founded upon a single observation, made in different hours of the day, and after an interval of a month or more, not perfectly sure.† I will illustrate this by the following corrected observations of 300 vibrations of my cylinder D here in Christiania, in the garden of the Observatory.

			h	′		″				h	′		″
1841, April	16,		4	31,	P. M.	811.93	1841, Sept.	1,		6	6,	...	810.65
... ...	22,		0	56,	...	812.74	... ...	...		7	38,	...	811.61
... ...	30,		8	5,	...	810.68	... ...	15,		10	12,	A. M.	811.63
... May	9,		7	8,	...	810.44	... ...	...		10	35,	...	811.80
... ...	23,		2	22,	...	811.02	... Oct.	8,		9	57,	...	812.62
... June	17,		6	43,	...	810.07							

The greatest difference between 1841, June 17, 6^h 43′ P. M., and 1842, Feb. 26, 10^h 32′ A. M., is 3″; and between 1841, June 17, and 1842, April 10, 5_h 29′ P. M. = 5″.17, under influence of aurora borealis.

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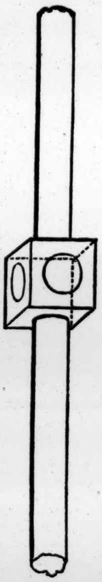
* The 30th July 1834, Hofrath Gauss observed the same cylinder in the same place in the garden of the Observatory, and found reduced time, T, of 300 vibrations = 759″.29, which gives intensity = 1.7672.

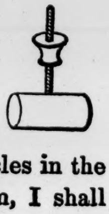
† [The value of the horizontal intensity at Edinburgh compared with Paris (.840) was not deduced, as Professor Hansteen supposes, from a single comparison. It was repeated by me in two different years with almost perfect agreement, and confirmed by observations at Brussels, a station independently compared with Paris. Professor Bache of Philadelphia has since found the same relative intensity for Edinburgh agreeing to the 3d decimal place.—J. D. F.]

			h	′		″	
1842,	Feb.	17,	0	5,	P. M.	812.14	
...	...	20,	5	21,	...	811.40	
...	...	22,	11	31,	A. M.	812.27	
...	...	...	4	31,	P. M.	811.85	
...	...	26,	8	36,	A. M.	812.27	The minimum of intensity here occurred at 10h 32′; the maximum later in the afternoon, after the last observation at 1h 41′ P. M. This day was a magnetical term, and the results of the vibration of the needle were in good harmony with the corresponding observations on the bifilar magnetometer.
...	...	...	8	56,	...	812.18	
...	...	...	9	15,	...	812.36	
...	...	...	10	14,	...	812.60	
...	...	...	10	32,	...	813.06	
...	...	...	10	51,	...	812.57	
...	...	...	11	10,	...	812.72	
...	...	...	11	30,	...	812.38	
...	...	...	1	3,	P. M.	811.97	
...	...	...	1	22,	...	812.24	
...	...	...	1	41,	...	811.91	
...	March	13,	5	44,	...	811.67	
...	...	20,	5	1,	...	811.97	
...	...	21,	5	0,	...	812.25	
...	...	25,	6	6,	...	811.35	
...	...	29,	6	48,	...	811.38	
...	April	10,	5	29,	...	815.24	Aurora Borealis.
...	...	...	6	0,	...	813,17	
...	...	11,	10	11,	A. M.	812.69	

In Göttingen I made 96 observations between 8 A. M. and 4½ P. M., from Aug. 27 to Sept. 10. In Dresden only 4, between Aug. 15 and 20; two A. M. and two P. M. When it is possible I generally in every place make at least two observations, one between 10 and 11 A. M., and the other between 4 and 6 P. M., in order to eliminate the daily variation.

Since 1819, I have very often observed the *dip* here in Christiania, with three different instruments, 1*st*, A 5-inch instrument by *Dollond*, divided to 20′, with two needles; the one cylindrical, with conical ends, and in the middle a cube, which is perforated in two directions, so that the axis can be inserted from four different sides, and turned round *ad libitum;* the other flat lancet-formed, in which the axis can be put in from two sides, and turned. 2*d*, A 6-inch instrument by *Ertel*, in Münich, divided to 10′, with a flat needle and three axes, which can be turned round *ad libitum*. 3*d*, An 8-inch instrument by *Gambey*, in Paris, with three needles and fixed axes. By the instrument 1*st* and 2*d*, after every complete observation, the limb east and west, and the needle in the four usual situations, the dip read of four times in every position, after having been lifted from the agate planes (in all thirty-two readings), the axis was turned 90°, and a second observation made. This was continued four times, till the axis arrived in its former position. In all three instruments the needle very often was brought out of equilibrium, by the application of a little tube, with a screw perpendicular to its axis, upon the axis of the needle. This is useful, in order to diminish the influence of the form of the pivots, especially on needles with fixed axis; and the influence of magnetical particles in the circle; shortly, to diminish constant errors. After this proëmium, I shall communicate my observations and their results.





	Year. *t*.	*n*.	δ	Observed. *i*.	Calculated.	Δ
			′	° ′	° ′	′
Dollond,	1819,857	9	2.915	72 39.00	72 41.62	— 2.62
	1820,397	9	1.410	... 43.63	... 39.67	+ 3.96
	1820,496	9	1.892	... 44.90	... 39.31	+ 5.59
	1820,678	9	1.212	... 42.70	... 38.72	+ 3.98
	1820,823	8	2.059	... 48.05	... 38.15	+ 9.90
	1821,159	7	3.587	... 47.80	... 36.96	+ 10.84
	1821,226	7	2.873	... 37.60	... 36.72	+ 0.88
	1821,303	7	3.517	... 42.90	... 36.45	+ 6.45
	1822,262	7	1.809	... 33.30	... 33.16	+ 0.14
	1822,548	6	3.757	... 33.80	... 32.19	+ 1.61
	1823,373	8	2.503	... 16.80	... 29.47	— 12.67
	1825,144	8	2.828	... 21.80	... 23.87	— 2.07
	1825,155	8	2.741	... 21.60	... 23.83	— 2.23
Ertel,	1828,325	10	2.325	... 16.20	... 14.69	+ 1.51
	1830,497	5	1.757	... 6.50	... 9.08	— 2.58
Gambey,	1830,877	8	0.753	... 7.16	... 8.15	— 0.99
	1831,251	7	0.508	... 8.71	... 7.26	+ 0.45
	1832,521	4	0.414	... 0.56	... 4.33	— 3.77
	1838,405	7	1.042	71 57.58	71 53.14	+ 4.44
	1839,823	14	0.851	... 53.54	... 51.02	+ 2.52
	1841,304	3	2.732	... 45.36	... 49.05	— 3.69
	1841,769	7	0.888	... 51.66	... 48.49	+ 3.17
	1842,179	12	0.806	... 46.60	... 47.63	— 1.03

t is the mean time of the observations in every group; n the number of complete observations in every mean; d the probable error of every mean; i the mean dip of the n observations. As the dip i in a not too long interval of time $t - t_0$ may be expressed by the following formula,—

$$i = a + b\,(t - t_0) + c\,(t - t_0)^2$$

where $a, b,$ and c are constants, I have taken $t_0 = 1820$, and by the method of least squares found

$$\begin{aligned} a &= 72^\circ\ 41'.1 \pm 1'.935 \\ b &= -3'.63978 \pm 0'.21654 \\ c &= +\ 0'.056166 \pm 0'.008749; \end{aligned}$$

and from these constants calculated the dip in the 5th column. Δ is the difference between observation and formula. The instrument of Dollond was too little, but the great number of observations (102 in 5.3 years), and the great variety of methods which have been employed, I suppose may have destroyed all constant errors. Since better instruments were employed, the quantity of Δ is much less; and I think that all these differences are not really errors of observation, as it is evident that the dip has its irregular variations as well as all other magnetic phenomena of the earth. The formula—

$$i = 72^\circ\ 41'.1 - 3'.63978\,(t - 1820) + 0'.056166\,(t - 1820)^2$$

with the probable errors of a, b, and c, gives

Minimum in Christiania $= 71^\circ\ 42'.2 \pm 11'.718$
when $t = 1852.4 \pm 5.4$ years.

I have found, that the dip in Paris, observed between 1798 and 1836, may be represented by the following formula:—

$$i = 69^\circ\ 38'.9 - 4'.465\,(t - 1800) + 0'.023395\,(t - 1800)^2,$$

which gives the minimum $i = 66^\circ\ 5'.8$ when $t = 1895$.

That the dip cannot decrease to zero, and, accordingly, should have a minimum, is quite probable; by these two series of observations, this minimum is likely to arrive before the end of this century, perhaps earlier in northern than in southern latitudes.

I am not quite of your opinion, that the observations with a dipping needle should be rejected *only* while it gives a difference of a degree and a half between the different positions. This difference may be derived from two different causes,—the *eccentrical position* of the *centre of gravity*, and the *deviation* of the *form* of the *pivots* from a *true cylinder*. In the first case the mean will approximate very nearly to the true dip, if the moment of the needle before and after the reversion of the poles is not too different; and when the needle is magnetized with the same four magnets, and the same number of strokes, this will scarcely arrive. In the second case, the needle will give *different errors* by *different dips*. This error can be detected by turning the axis in the needle in different observations in the same place, or by applying an eccentrical weight upon the axis, if it is fixed. When the moment of this weight is varied in the different observations, the needle will repose upon different points of the pivots in different observations, and thereby the error will be diminished, if not quite eliminated. I think this has been the case with your needle A.1, as the difference A.2 — A.1 changes its sign by diminished dip.

	A.1.	A.2.	A.2 — A.1.
	° ′	° ′	′
Edinburgh, ...	71 57.8	71 55.1	— 2.7
Greenwich, ...	69 12.4	69 11.5	— 0.9
Brussels, ...	68 36.4	68 28.5	— 7.9
Berlin, ...	68 1.9	68 5.5	+ 3.6
Bonn, ...	67 49.1	67 51.3	+ 2.2
Göttingen, ...	67 47.0	67 53.5	+ 6.5
Carlsbad, ...	66 36.0	66 47.5	+ 11.5
Wien, ...	64 41.2	64 51.0	+ 9.8

It is also my opinion, that even the best needle may, by a single observation, give an error of three to five minutes (perhaps more), including error of observation, and irregular variation of the direction of magnetical force of the earth. I shall here offer some observations with Gambey's instrument here in Christiania, in 1839.

Time of Observation.	Needle.	*n.*	Marked end, N. P.		Marked end, S. P.		Dip.	
			a.	*b.*	*c.*	*d.*		
Sept. 30, 5½ P. M.	II.	24	72° 0′.9	73° 11′.6	72° 0′.5	70° 2′.7	71° 48′.9	After these three observations I better equilibrated both needles upon a stone the 2d October.
Oct. 1, 0½ P. M.	III.	32	70 27.3	70 33.2	73 18.6	73 24.0	71 55.8	
... ... 2 P. M.	II.	32	72 8.55	73 8.1	71 58.3	70 23.3	71 54.6	
... 3, 10 A. M.	III.	32	71 56.7	71 46.8	71 54.2	72 0.8	71 58.2	*Aurora Bor.* 8½ P. M.
... ... 10¾ A. M.	II.	32	71 53.1	71 58.6	71 55.45	71 13.9	71 45.26	
... 13, 2 P. M.	III.	32	71 59.9	71 40.8	71 42.1	71 50.6	71 48.3	Strong *A. B.* the 12th, 9¾ P. M. behind the clouds.
... 27, 2 P. M.	III.	31	71 47.3	72 1.4	72 21.7	72 1.1	72 2.9	
Nov. 7, 10 A. M.	I.	34	72 50.65	69 57.05	71 21.0	73 13.5	71 50.55	
... 17, 1¼ P. M.	III.	32	87 51.3	58 22.5	58 11.7	88 6.7	71 54.7	Eccentric *weight* upon the axis.
... 18, 11¾ A. M.	III.	32	58 3.6	87 59.0	87 47.5	58 30.5	71 52.2	Weight turned round the axis 180°.
... 19, 1½ P. M.	II.	32	58 51.8	87 50.2	88 36.5	57 28.5	71 56.9	Weight.
... ... 2½ P. M.	II.	32	88 6.8	58 42.6	58 9.4	87 37.6	71 57.3	Weight turned round 180°.
... 20, 11 A. M.	I.	32	96 58.4	51 51.7	54 6.8	94 7.2	71 49.2	Weight (this needle has a weaker magnet.)
... 21, 2½ P. M.	I.	34	53 55.0	92 47.3	92 24.1	56 9.3	71 54.7	Weight turned.
						Mean,	71 53.54	

n is the number of readings in each series ; *a* the dip, when the marked side of the needle turned to east, four readings with limb east, and four when west ; *b* the dip, when the marked side was west, and limb both east and west ; *c* and *d* the same, after changing the poles. When the weight was applied, the dip is calculated by the formula—

$$\tan i = \frac{\operatorname{cotang} a + \operatorname{cotang} d - \operatorname{cotang} b - \operatorname{cotang} c}{\operatorname{cotang} a \,.\, \operatorname{cotang} d - \operatorname{cotang} b \,.\, \operatorname{cotang} c} ;$$

and by this method the different magnetical moment of the needle, before and after the returning of the poles, is quite eliminated. The eight first observations, without weight, give 71° 53′.1, the last six, with weight, 71° 54′.2, and the probable error of the mean of the whole series is 0′.851. Though the probable error of the three determinations 1839, 823 (14 obs.), 1841, 769 (7 obs.), 1842, 179 (12 obs.), are only 0′.851, 0′.888, and 0′.806, their deviations from the formula are respectively + 2′.52, + 3′.17, and — 1′.03, which, I think, may principally be ascribed to irregular variations in the dip.

I beg your pardon for my profusion in this matter, but my long experience with different instruments of this kind has made me somewhat sceptical in the way of observing the dip, and I am not content before I have varied the methods of observation, and multiplied the observations as much as possible.

In observing the intensity by vibrations of a magnetical cylinder, you are almost the only observer who has not neglected one or more of the necessary reductions, as that for temperature, rate of the chronometer, force of torsion, arc, and to observe the cylinder in the same place before and after the voyage. Some have neglected them all, and thereby brought the method in an undeserved miscredit.

If you should desire any other communications which are in my power to procure you, I shall make them with great pleasure. I am, Sir, with the greatest respect, your obedient and humble Servant,

CHR. HANSTEEN.

To Professor FORBES.

2. Notice of the occurrence in Scotland of the *Tetrao medius*, shewing that supposed species to be a hybrid. By James Wilson, Esq.

There exists in several northern continental countries a peculiar kind of grouse, called by foreign naturalists *Tetrao medius*, on account of its exhibiting, as it were, a combination of the characters of the wood-grouse or capercailzie on the one hand, and of the black-cock on the other. It is never found except in countries inhabited by the two species last named; and as it presents a union of their characters, several naturalists have inferred that it is not itself a distinct kind, but a hybrid, resulting from the casual intercourse of the other two. But most naturalists have maintained that it is a distinct species, chiefly upon the principle, that, in the wild state, birds of different species do not intermingle sexually with each other. Mr Wilson, however, having discovered that, in certain districts of Scotland into which Lord Breadalbane has lately introduced the capercailzie, and in which the black-cock previously existed in abundance, this so-called intermediate grouse has also now made its appearance, he draws the conclusion, that it is not a distinct species, but a hybrid or mule. "It had not been previously known in Scotland, at least in our times,—it has not been introduced by any one from abroad,—and yet here we now find it in the very districts inhabited by the other two." Mr Wilson exhibited a specimen recently killed on the estate of Dunira, and shewed its entire agreement with the foreign *T. medius*, by comparing it with a specimen from Norway.

3. On the Coloration of the Blood. By the late Daniel Ellis, Esq., F.R.S.E. Communicated by Dr Christison.

[*Note.*—During the latter part of his life, Mr Ellis had been engaged in drawing up a statement of his views with regard to the function of respiration in animals generally; and having, for some years previous to his death, had it in contemplation to lay before the Royal Society an account of that part of his researches which relates to the cause of the change of colour of the blood in its passage through the lungs, he had prepared and nearly completed the paper on this subject, of which the following is a short abstract. It may be proper to state that no reference is made in the paper to the recent experiments of Magnus, which are now generally held to afford incontrovertible proof of the existence of free carbonic acid in greater, and of oxygen in less quantity, in venous than in arterial blood. These experiments came to be known in this country only a short time before Mr Ellis's death, and, had he been acquainted with them, might have tended to modify his views.]

In the first part of the paper, the author states that he still maintains the opinion expressed in his published work on respiration, viz., that the quantity of carbonic acid formed in respiration is exactly equal to that of the oxygen consumed; and he enters into a detailed critical analysis of the different experiments recorded by authors on this subject, placing, however, his chief reliance upon those of Berthollet, and of Allen and Pepys, in order to justify his opinion. He also holds the view that the exhalation of carbonic acid and consumption of oxygen are not independent processes, but are the immediate result of the direct union of carbonic and oxygen within the air-cells of the lungs, and he expresses doubts as to the accuracy of the experiments of Edwards, which have by many been held to establish the opposite view.

Proceeding upon this basis, the author next examines the effects of air and other re-agents upon blood out of the body, and deduces the conclusion, that, although oxygen gas appears to have the direct effect of changing the colour of the blood from dark to bright red, that change may be induced without the presence of any oxygen gas, and that within the living body, it is not necessary to attribute the change to the agency of that gas. In proof of this, the author refers particularly to the experiments of Stevens and of Gregory, and he also details experiments made by himself, which shew that, while a strong saline fluid has of itself the power of changing the colour of the blood, weaker saline solutions, or such as contain no more salt than is naturally dissolved in the serum of the blood, do not effect any change unless oxygen gas be also present; and that water, which contains dissolved in it less than $\frac{1}{160}$ part of its weight of salt, does not brighten blood even in air.

The author forms the conclusion, that we must seek some other cause of the coloration of the blood than the direct action of oxygen. That cause he conceives to be of the nature of electricity. He refers to various experiments which shew that electricity produces the effect of reddening the blood, and he explains the development of electricity in respiration, by supposing that the heat evolved by the combination of carbon with oxygen in the lungs, becoming latent, is converted into electricity, and there produces its effect on the colouring matter of the blood. That effect the author holds to consist in the decomposition of the saline ingredients of the serum, the consequent separation of a quantity of free alkali, which, acting on the hematosine, changes its colour from dark to bright red.

The following Donations of Books to the Society's Library were announced.

Astronomical Observations made with Ramsden's Zenith Sector, together with a Catalogue of the Stars which have been observed, and the amplitudes of the Celestial Arcs, deduced from the observations at the different stations. Published by order of the Board of Ordnance.—*By the Master-General, &c.*

Proceedings of the London Electrical Society. Part 6. Session 1842-43.—*By the Society.*

Bulletin de l'Académie Royale des Sciences et Belles Lettres de Bruxelles. 1842. Nos. 3-9.

Nouveaux Mémoires de l'Académie Royale des Sciences et Belles Lettres de Bruxelles. Tome xv.

Annales de l'Observatoire Royal de Bruxelles. Publiées par le Directeur, A. Quetelet. Tome ii.—*By the Royal Academy.*

Annuaire Magnétique et Météorologique du Corps des Ingénieurs des Mines de Russie ou Recueil d'Observations Magnétiques et Météorologiques faites dans l'étendue de l'Empire de Russie. Par A. T. Kupffer. Annee 1840.—*Par l'Administration Imperiale des Mines.*

Astronomische Nachrichten. Nos. 447-461.—*By Professor Schumacher.*

Transactions of the Philosophical Society of Cambridge. Vol. VII. Part 3.—*By the Society.*

Scheikundige Onderzoekingen, gedaan in het Laboratorium der Uttretchtsche Hoogeschool. Stuk. 4.—*By the Editors.*

Donations to Museum—

Specimens illustrative of Mr Stark's paper on the Food of the Herring and Salmon.—*Presented by John Stark, Esq.*

Specimens of the Woods of Ceylon (fifty different kinds.)—*Presented by J. Anstruther, Esq.*

Specimens of Minerals and Fossil Organic Remains from Malta, the Ionian Islands, and Ceylon.—*Presented by Dr John Davy.*

Geological Specimens from the Velay and Vivarais (Haute Loire and Ardêche.)—*Presented by Professor Forbes.*

Monday, 9th January 1843.

Dr ABERCROMBIE, Vice-President, in the Chair.

The following communications were read:—

1. On the Growth of the Salmon. By Mr Andrew Young, Invershin, Sutherlandshire. Communicated by James Wilson, Esq.

Mr Young has here taken up the subject of the salmon's growth where it was necessarily left off by Mr Shaw. So far as the earliest or fresh-water state of the fish is concerned, he entirely agrees with the observer just named. He then states the various opinions which prevail regarding the more or less rapid growth of smolts and grilse, and shews by tabular lists (the result of frequently repeated experiments), that the increase in their dimensions is extraordinary so soon as they descend into the salt water. So far back as the months of April and May 1837, he marked a number of descending smolts, by making a peculiar perforation in the caudal fin, by means of small nipping irons constructed for the purpose. He re-captured a considerable number of them ascending the rivers as grilse, in the course of the ensuing months of June and July, and weighing several pounds each, more or less according to the difference in the length of their sojourn in the sea. Again, in April and May of 1842, he marked a number of descending smolts, by clipping off the little adipose fin upon the back. In June and July he caught several of them returning up the river, and bearing his peculiar mark,—the adipose fin being absent. Two of these specimens were exhibited to the Society. One marked in April, and re-captured on the 25th of July, weighed 7 lbs.; the other, marked in May and re-captured on the 30th July, weighed 3½ lbs. As the season advances grilse increase in size, those being the largest which abide the longest in the sea. They spawn in the rivers after their first ascent, and before they have become adult salmon.

Mr Young also described various experiments instituted with the view of shewing the transition of grilse into salmon. He marked many small grilse after they had spawned in winter, and were about to re-descend into the sea. He re-captured them in the course of the ensuing summer as finely-formed salmon, ranging in weight from 9 to 14 lbs., the difference still depending on the length of their sojourn in the sea. He has tried these experiments for many seasons, but never twice with the same mark. A specimen marked as a grilse of 4 lbs. in January 1842, and re-captured as a salmon of 9 lbs. in July, was exhibited to the Society. It bore a peculiarly twisted piece of *copper* wire in the upper lobe of the caudal fin. Those marked and retaken in 1841 were marked with *brass* wire in the dorsal fin. With these and other precautions Mr Young avoided the possibility of any mistake as to the lapse of time. Both grilse and salmon return uniformly to their native streams; at least it very rarely happens that a fish bearing a particular mark is found except in the river where it was so marked. Salmon in the perfect state as to form and aspect, also increase rapidly in their dimensions on again reaching the sea. A spawned salmon weighing 12 lbs. was marked on the 4th of March, and was re-captured on its return from the sea on the 10th of July, weighing 18 lbs. Mr Young is of opinion that salmon rather diminish than increase in size during their sojourn in rivers; and he illustrates this and other points of his subject by numerous experiments and observations.

2. On the Geology of Roxburghshire. Part 2. By David Milne, Esq.

Mr Milne divided his paper into two parts, the first comprehending a description of the leading geological features of the district; the second containing the inferences of a cosmological character, which the facts related in the first part seemed to warrant.

In describing the geology of Roxburghshire, Mr Milne referred, *first*, to the stratified rocks; *secondly*, to the igneous rocks; and, *thirdly*, to the superficial, or (as they have been sometimes termed) the diluvial deposits.

The stratified rocks were stated to consist of the following series, beginning with the oldest, viz.—greywacke, old red sandstone, and the coal measures. As to the long disputed question regarding the existence of the new-red-sandstone formation in this county, Mr Milne, whilst not wishing to affirm absolutely the non-existence of any strata whatever belonging to this epoch, referred to the older formation the great mass of the red sandstones abounding in the district, adding that he had himself seen none which necessarily belonged to a later epoch.

It was stated that no fossils had been found in the greywacke strata, but that in the old red sandstone formation, scales and bones of the *Holoptichius* had been found embedded both in the red and the white coloured strata.

The igneous rocks consist of all the varieties of felspars, basalts and greenstones, known in other parts of Scotland, the first mentioned of these being the oldest. All these rocks occur in the form of dykes, as well as hills, of which the Eildons and Cheviots are the highest and most extensive.

The superficial deposits consist, beginning with the oldest, of the boulder clay, well known in the Lothians,—of sand and gravels,—and of great blocks or rounded fragments of rocks, all strewed over the surface. It was mentioned, that, whilst the boulder clay was deposited in tumultuous waters (presenting no signs of stratification), the sands and gravels being for the most part stratified, have been deposited by waters not in violent action. The greater number of boulders in Liddesdale consist of grey granite, very similar to that of Criffel, situated between thirty and forty miles to the westward.

In part 2d, the author observed, that the greywacke formation, presenting as they do enormous foldings, in consequence of which the formation is traversed by ridges and valleys, all running east and west by compass, must have been acted on here, as throughout the rest of this part of the island, by a force or system of forces, which acted in a particular direction; and that as hardly any igneous rocks whatever occur, within the limits of this formation, it seemed that the greywacke strata had not been elevated and folded together by igneous action, but more probably in consequence of changes in the form of the Earth's nucleus, as suggested by Elie de Beaumont.

The elevation of the greywacke ranges was followed by eruptions of felspathic and a few greenstone rocks, which took place chiefly on the outskirts of that formation; and from the sediment afforded by the wearing down of these rocks, still at the bottom of a sea, the stratified rocks surrounding and partly covering these older rocks were formed. As the heaviest sediment would be deposited first, the sandstones filled with oxide of iron, and now constituting the principal beds of the old red sandstone formation, would girdle the hills of greywacke and older felspathic rocks, whilst the strata of white sandstone, shales, and limestones, being composed of lighter sediment, would be carried farther, and become members of the coal measures situated in Liddesdale, Northumberland, and Berwickshire.

The formation of the whinstone dykes, one of which was described as running in a NW. direction, for about twenty-four miles, was ascribed by the author to the irruption of igneous matter into fissures previously formed in the earth's crust.

The beds of gravel and sand, as well as the boulders, the author thought might all be explained on the supposition, that the district had been covered by the waters of the ocean, when they were deposited. He adduced facts and arguments for the purpose of shewing that certainly none of these deposits could have been formed by glacial action, and that probably submarine currents, or great waves, such as are known to have been produced by submarine eruptions, would be sufficient to account for all the phenomena.

3. On the Property of Transmitting Light, possessed by Charcoal and Plumbago, in fine plates and particles. By John Davy, M.D., &c.

The charcoal of the pith of the elder consists of plates of extraordinary thinness. It was in examining this charcoal, that the author first observed the property which is the subject of his paper. He detected it by means of the microscope, using a high magnifying power. By analogy, he was led to infer that the power of transmitting light must belong to charcoal in general, in all its varieties, when reduced to the state of fine powder or filaments,—an influence which he found confirmed by experiment in a number of different instances, as the charcoal of the pith of the sycamore, of the pith of the rush, the fibre of cotton, flax, &c. He also found it to belong to lamp-black, to cork in very fine powder, to anthracite, and plumbago.

The light transmitted he found to vary in its hues, from almost white, as in the instance of the thinnest plates of the charcoal of the pith of the elder, to brown and red of various shades, in the instances of lamp-black, anthracite, and plumbago.

He considers the property of translucency belonging to charcoal and plumbago, in their finely divided state, as favourable to the opinion now commonly received, that these substances and diamond owe their marked peculiarities not to difference of chemical mixture, but of mechanical structure. Incidentally, he notices the specific gravities of these substances,—stating, as the result of his own experiments, that the specific gravity of charcoal, cork, and anthracite, is about 1.5; and that of plumbago about the same, making allowance for the ferruginous and earthy matter with which the carbon in this mineral is mixed.

In conclusion, he offers the conjecture, that the coloured tints of vapour and fluids in which carbon is suspended, may be connected with the translucency of this substance, and that other bodies, hitherto considered opaque, may be found capable of transmitting light, when examined in a manner similar to that which he has employed.

The following Donations of Books to the Society's Library were announced.

Maps of the Ordnance Survey of England and Wales. Nos. 80, 81, and 90.—*By the Master-General of the Ordnance.*

Maps of the Irish Ordnance Survey, containing the County of Clare. 77 sheets.—*By His Excellency the Lord-Lieutenant.*

Report made at the Annual Visitation of the Armagh Observatory. By the Rev. T. R. Robinson, D.D.—*By the Governors of the Observatory.*

Proceedings of the American Philosophical Society. Vol. II. No. 23.—*By the Society.*

Journal of the Asiatic Society of Bengal. Nos. 122 and 123.—*By the Society.*

Donations to Museum—

Specimens of Fossil Organic Remains from East Kilbride and neighbourhood, Lanarkshire. Collected by the late Rev. David Ure, A.M.; and a number of them figured in his "History of Rutherglen and East Kilbride."—*Presented by John Stark, Esq.*

Tail of a Wild Elephant from Ceylon.—*Presented by Rob. Bryson, Esq.*

Specimens of Fossil Fishes from Syria.—*Presented by Dr John Davy.*

Monday, 23d January.

The Very Reverend Principal LEE, Vice-President, in the Chair.

The following communications were read:—

1. Chemical Observations on the Flowers of the Camellia Japonica, Magnolia grandiflora, and Chrysanthemum

Leucanthemum; and on three proximate principles which they contain. Part I. By Dr Hope.

The Abstract of this Paper has been postponed till the remaining part of it shall be communicated.

2. On the Law of Visible Position in Single and Binocular Vision, and on the Representation of Solid Figures by the union of two dissimilar plane figures on the Retinæ. By Sir David Brewster, K.H. Part I.

The Abstract of this Paper also has been postponed till the whole shall have been read before the Society.

The following Donations of Books to the Society's Library were announced.

Proceedings of the London Electrical Society. Part 7.—*By the Society.*

De Fide Uranometriæ Bayeri Dissertatio Academica. Scripsit D. F. G. A. Argelander.—*By the Author.*

Memoirs of the Royal Astronomical Society. Vol. XII.—*By the Society.*

Philosophical Transactions of the Royal Society of London. 1842. Part ii.—*By the Society.*

Kongl. Vetenskaps-Academiens Handlingar, för Aren 1839-40.

Arsberättelse om framstegen i Fysik och Kemi Afgiven den 31 Mars 1839 and 31 Mars 1840. Af Jac. Berzelius.

Ärsberättelse om Technologiens Framsteg, Afgiven den 31 Mars 1839 and 31 Mars 1840. Af G. E. Pasch.

Arsberattelser om nyare Zoologiska Arbeten och Upptackter. Afgifne för Aren 1837-40. Af C. J. Sundewall.—*By the Royal Swedish Academy.*

Donation to Museum—

Three Specimens of Salmon, shewing the rapid growth (on descending to the sea) of the Smolt to the state of Grilse, and of the latter to the adult condition.—*By Mr Andrew Young, Sutherlandshire.*